

The Biology of the North American Crane-Flies

(Tipulidae, Diptera)

VI. The Genus *Cladura* Osten Sacken

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Generic Diagnosis

Larva. Form comparatively short and stout; integument provided with a delicate appressed pubescence; no distinct setae; basal annulus of each of abdominal segments two to seven with a transverse area of microscopic points arranged in long, transverse rows. Last ventral segment with a flattened lobe covered with short setae, evidently an organ for shoving. Spiracular disk entirely without lobes, the spiracles being situated on the exposed dorso-caudal surface of the last abdominal segment. Head-capsule relatively compact; frontal plate broad, only slightly narrowed behind. Labrum quadrate, with conspicuous, oval, lateral arms; antennae two-segmented, the terminal segment elongate-oval; mandibles of a herbivorous type, with an apical point and two incomplete rows of teeth on the inner or cutting face; mental bars widely separated, each bar provided with two acute teeth at its mesal end.

Pupa. Cephalic crest gibbous, entire or feebly bifid, armed on either side with a single powerful bristle; two bristles on both the front and vertex; labrum with pair of small bristles at each cephalic-lateral angle; labial lobes subquadrate, weakly separated by the apex of the labral sheath; palpal sheaths short and stout, straight; lateral margins of eye produced laterad into a digitiform lobe; antennal sheaths extending to opposite one-third the wing-sheaths. Pronotal breathing horns lacking, entirely sessile; pronotum and mesonotum armed with conspicuous bristles; wing-sheaths ending opposite the base of the third abdominal segment; leg-sheaths long, ending opposite the base of the sixth abdominal segment, the hind legs longest, the middle legs shortest. Abdominal tergites with ten strong bristles, eight being arranged in a single transverse row along the posterior margin; abdominal pleurites with four strong bristles, one on anterior ring, two near the caudal margin of the posterior ring, one ventrad of the spiracle; spiracles rudimentary, situated on segments two to seven; sternites unarmed with bristles.

Discussion of the Genus

The genus *Cladura* was erected by Osten Sacken in 1859 (Proc. Acad. Nat. Sci. Phila., p. 229). The genus includes but six

known species, with a Holarctic distribution, there being two species from eastern North America, one from western North America, and three from Japan. Of the eastern North American species, the most common and best-known is the genotype, *Cladura flavoferruginea*. The six known species of the genus are all forms that appear on the wing in late summer and in autumn.

The only reference to the immature stages of this curious genus is the brief diagnosis by the writer (The Crane-flies of New York, Part II. Biology and Phylogeny. Cornell University Agricultural Experiment Station. Memoir 38. p. 949; 1921). The genotype is common and widely distributed throughout the northeastern United States, but until the present year the writer had been unable to locate the immature stages. The conditions under which these stages occur are briefly outlined herein.

Agurville, or Brownsfield, Woods, near Urbana, Illinois, is an open, low Transitional or upper Austral woodland, traversed in spring and early summer by a small stream. In early spring the valley through which this brook flows is carpeted with a dense growth of Blue-eyed Mary (*Collinsia verna*). On the higher ground and dry slopes, other characteristic spring flowers, such as *Trillium recurvatum*, *Claytonia virginica*, squirrel-corn, dutchman's breeches, blood-root, white trout-lily, and other forms, occur in numbers. The forest cover consists of linden, hard maple, buckeye, hackberry, bur oak, honeylocust, and a few less common species, certain individuals of all of these species being giants of their kind and evidently members of the primitive forest. The undergrowth consists principally of pawpaw and spice-bush, together with considerable reproduction of buckeyes and other trees. In the autumn, the vernal flora is replaced by the dominant wood-nettle, many species of *Aster* and *Solidago*, some *Eupatorium* and other late summer plants. Adults of *Cladura flavoferruginea* were found in these woods during the fall of 1919.

On September 5, 1920, Mrs. Alexander and the writer began a systematic search for the larvae of *Cladura*. Earlier experience in Maine, New York, and Kansas had demonstrated that it was highly improbable that the early stages were to be found in mud, or even in damp earth, or in decaying wood, these habitats being those commonly frequented by the early stages of the Tipulidae. A careful search was instituted in soil that was baked comparatively hard and dry. The lumps were dug out and crumbled into dust, the contents being carefully examined. This method of search soon revealed a short, stout, light yellow crane-fly larva, that was at once determined as probably being that of *Cladura*. On this date, the only other insects associated with this larva were larvae of the Scarabaeid, *Xyloryctes satyrus* (Fabr.), a Tenebrionid, *Meracantha contracta* (Beauv.), and a few adult Corabidae and Staphy-

linidae. The conspicuous millipede *Spirobolus marginatus* (Say), was also found in these situations. The soil was covered with a layer of dead leaves and other vegetable detritus, but this had not been sufficient to prevent the dessication of the soil to a depth varying from six to twelve inches or more. Three larvae taken on September 5 were placed in breeding vials.

On September 19, 1920, Mrs. Alexander and the writer continued the search in these same haunts, and this resulted in the discovery of six additional larvae and four teneral pupae. As before, they occurred in soil that was very dry, underneath a layer of leaf-mold and other debris. These were placed in rearing.

On September 29, 1920 the writer again went to Augurville Woods. The weather was very cold and raw. By careful searching, eight pupae were discovered, some being very dark colored and evidently nearly ready to transform to the adult condition. These were placed in tin salve boxes for rearing. On the following day, two females of *Cladura flavoferruginea* emerged from two of the pupae discussed above. Other adults emerged during the following week. The remaining larvae and pupae were preserved in alcohol.

Bergroth and other writers had surmised the relationship of *Cladura* to the nearly apterous snow-fly, *Chionea* Dalman, a fact that is amply substantiated by the discovery of the larvae of the two genera. Brauer, Egger and Frauenfeld (1854) had taken gravid females of the commonest European species of *Chionea*, *C. araneoides*, and confined them in breeding jars, where they laid a large number of eggs, which hatched into stout yellow larvae that agree in many features of their organization with the larvae of *Cladura* described in this paper. Unfortunately the larvae of *Chionea* have never been carried through to the pupal condition.

The larvae of the two genera agree in their short, stout form, the obliquely truncated spiracular disk that is quite devoid of surrounding lobes, and in the general features of the head capsule. The pupa of *Cladura* is notable by the entire lack of protuberant breathing-horns, the breathing-pores being entirely sessile. The nearest approach to this condition in the Tipulidae is found in the genus *Dicranoptycha* Osten Sacken, which is likewise characteristic of unusually dry conditions in open upland woods. Other notable features of the pupa of *Cladura* are found in the very elongate leg-sheaths and the unusual development of long setae on the dorsal and pleural regions of the abdomen. The pupa is very small compared with the adult which emerges from it.

Natural Affinities

The genus *Cladura* unquestionably belongs to the tribe Eriopterini where it was placed by Osten Sacken. The discovery of the immature stages confirms the belief that this genus, as well as *Chionea* Dalman, and probably *Crypteria* Bergroth and *Ptero-*

chionea Alexander, should be isolated from the Eriopteraria where now placed and made a separate subtribe, the Chionearia or Claduraria, the former name being based on the oldest genus.

DESCRIPTION OF THE IMMATURE STAGES

Larva—Length (fully grown), 10-10.5 mm.

Diameter, 1.2 mm.

General coloration light yellow throughout.

Form comparatively short and stout. Integument provided with a delicate appressed pubescence; no distinct setae. Abdominal segments divided into a narrow basal annulus and a much broader posterior annulus, the latter being approximately two and one-half times as long as the former; the ventral surface of the basal annuli of abdominal segments two to seven with a conspicuous transverse area of microscopic points arranged in long transverse rows.

Spiracular disk entirely destitute of lobes, the spiracles being located on the obliquely truncated dorso-caudal surface of the last abdominal segment. Spiracles circular, the ring pale, the centers dark; spiracles separated from one another by a distance about equal to or a little less than the diameter of one. Ventral surface of the terminal abdominal segment with a projecting, flattened lobe that is provided with a dense brush of short, pale setae, this organ presumably being used for propelling the insect through the soil.

Head entirely retractile. Head-capsule very compact for a member of the Eriopterini. Frontal plate broad, only slightly narrowed behind, the apex obtuse or subtruncate. Labrum-epipharynx quadrate, the surface covered with short, dense hairs; on either side a stout oval arm or lobe directed cephalad, these arms connected by narrow bars, with the frame-work of the head. Mental bars entirely separate, each bar with two acute teeth on the cephalic side immediately before the apex. Antennae two-segmented, the basal segment short-cylindrical, the terminal segment elongate-oval, gradually narrowed to the obtuse apex. Mandibles relatively slender, of a herbivorous type, the teeth blunt: apical point small; two incomplete rows of flattened obtuse denticles along the inner face of the mandible, the outermost tooth of each row largest, the others gradually smaller, becoming subobsolescent: the basal teeth are very tiny, arranged in short combs; proximal caudal angle of the mandible produced into a cylindrical chitinized bar. Maxillae consisting of simple hairy lobes.

Pupa—Length, 6.7 mm.

Width, d.-s., 1.4 mm.

Depth, d.-v., 1.4 mm.

The coloration of newly transformed pupae is pale yellow. In older individuals, the thorax, head and sheaths of the appendages gradually deepen in intensity to almost black in specimens about to transform.

Cephalic crest projecting between the antennal bases as a gibbous lobe that is entire or microscopically bifid, on either side with a conspicuous erect bristle situated immediately dorsad of the base of the antenna. Vertex between the cephalic ends of the eyes with a strong bristle on either side, immediately caudad of each of which is a small tubercle. Frontal region likewise with a pair of strong bristles that are somewhat appressed against the face, directed caudad. Labral sheath with the apex rounded, very narrowly separating the labial lobes; at the base of the labrum on either side are two small bristles; sheaths of the palpi short but stout. Lateral margin of the eyes produced laterad and slightly caudad and dorsad into a conspicuous finger-like lobe. Antennal sheaths extending to about opposite one-third the length of the wing-sheath.

Pronotal breathing horns entirely lacking, the pores being sessile, lying immediately dorsad of the antennal sheaths. Pronotal scutum with two weak bristles behind the antennal sheaths; pronotal scutellum with three powerful bristles on either side near the summit. Mesonotum gibbous but unarmed with tubercles or spines. The following mesonotal bristles are evident: one on the ventral caudal angle immediately cephalad of the wing-root; a group of two, one being much smaller than the other, immediately at the wing-root; a transverse row of three strong bristles on either side, dorsad and proximad of the wing-root; two weak bristles slightly cephalad of the level of these latter three, one on either side of the median line; a strong bristle dorsad and cephalad of the pair at the wing-root. Metanotum with a strong bristle at the ventral cephalic angle. Wing-sheaths extending to opposite the base of the third abdominal segment. Leg-sheaths long, extending to opposite the base of the sixth abdominal segment; sheaths of the posterior legs longest, a little exceeding those of the fore-legs; middle legs shortest, ending immediately beyond the base of the last segment of the posterior sheaths.

Abdominal tergites and pleurites with very conspicuous bristles; sternites entirely unarmed. The distribution of the setae is as follows: On the tergites—no setae on the anterior annulus; on the posterior annulus a single transverse row of eight long bristles along the posterior margin of the segments, four on either side of the median line; cephalad of the outermost pair of these bristles and located on the anterior part of the posterior annulus is a single strong bristle on either side; on the eighth tergite there are only four bristles, arranged to form a rectangular or trapezoidal figure. On the pleurites,—each pleurite bears four very powerful bristles, one opposite the anterior annulus, one immediately ventrad of the

rudimentary spiracle, the remaining two in a transverse row on the posterior ring near the caudal margin; on the eighth pleurite there is a single bristle. On the sternites, no bristles. Terebra of the ovipositor ending almost on a common level, the tergal valves a very little longer; each tergal valve terminates in four rather weak bristles. In the male pupae, the sternal valves are slightly more tumid and project beyond the level of the tergal valves.

Nepionotype. Urbana, Illinois, September 19, 1920.

Neanotype. Urbana, Illinois, September 29, 1920.

Paratypes, larvae and pupae, September 5, 19, 29, 1920.

EXPLANATION OF PLATE

Fig. 1. Head capsule of larva, ventral aspect.

Fig. 2. Mandible

Fig. 3. Apex of mental bar.

Fig. 4. Antenna of larva.

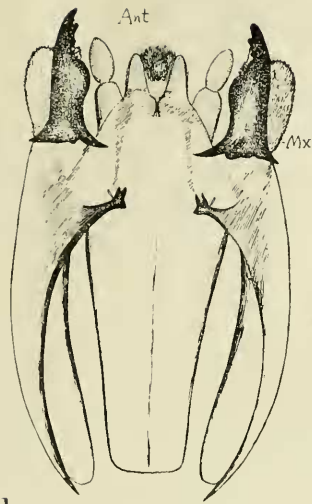
Fig. 5. Spiracular disk of larva, dorsal aspect.

Fig. 6. Spiracular disk of larva, lateral aspect.

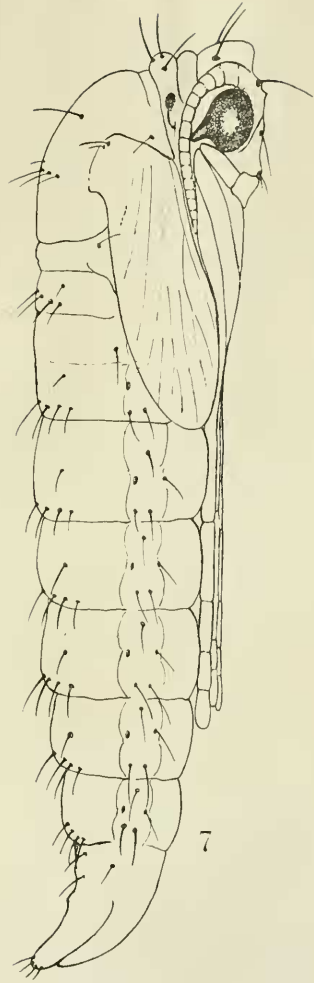
Fig. 7. Pupa, lateral aspect.

Fig. 8. Head of pupa, ventral aspect.

Ant.=Antenna; Lb.=Labium; Mx.=Maxilla; P.= Maxillary sheaths.



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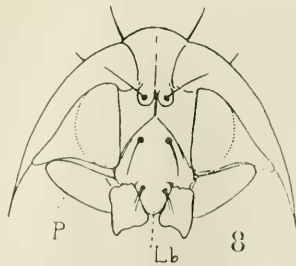
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